DeepImage: Layer-Specific Monitoring of Velocities and Q-factors using Seismic Interferometry

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As part of the project DeepImage, which is funded by the NWO programme DeepNL, we will develop seismic-interferometry (SI) tools based on non-physical reflections (also called ghost reflections) for monitoring layer-specific changes in the Groningen subsurface. These SI tools will be developed for application to active-source surface reflection data and borehole data, but also to induced earthquakes. Our aim is to estimate time-lapse changes in both P- and S-waves velocities and Q-factors. Using reflection data recorded with sources and receivers at the surface wold allow layer-specific velocity estimation along the reflection lines at multiple positions. Using borehole data from active sources at the surface would allow to use the ghost reflections to estimate layer-specific velocities and Q-factors but at the positions of the boreholes only. These will be used together with the results from the surface reflection data for calibration and interpolation between boreholes. Applying SI to induced earthquakes for retrieval of ghost reflections would allow estimation of both layer-specific velocities and Q-factors. We will show numerical and laboratory examples of ongoing research that will contribute towards the explained goals. We will show numerical examples for estimation of layer-specific velocity and Q-factors from ghost reflections using borehole data and laboratory ultrasonic results for monitoring displacement of brine by CO2 in a sandstone "reservoir" using ghost reflections retrieved from sources and receivers at the surface.